Northeast Salmon Team (NEST) Fact Sheet Collection

Rotary Screw Trap Operations

Atlantic salmon have a complex life history, spending 1-3 years in freshwater and then undertaking a strenuous migration into the marine environment. There, they spend an additional 1-3 years at sea before returning to their natal rivers to spawn. Although Atlantic salmon face many challenges during their freshwater phase (both natural and human-caused), their migration to the marine environment is even more arduous.

Not to scale

The parr-to-smolt transformation (smoltification) results in river adaptations giving way to seawater readiness.

Smolts undergo dramatic physiological changes before they are able to transition from freshwater to the saline marine environment. During this transition period, smolts encounter unfamiliar environmental conditions and a new complex of predators including seals, and *piscivorous* (fish-eating) waterbirds and fish.

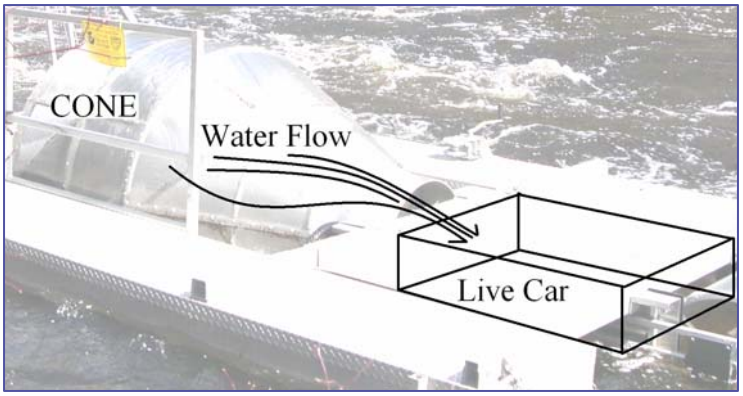
Telemetry data suggest that although the majority of smolts successfully migrate through the freshwater environments of Maine's coastal river systems, less than half successfully enter the Gulf of Maine.

Double-crested cormorants feeding

Stomach contents of this striped bass included a smolt

Rotary screw traps (RSTs) enable NEST to live-capture smolts emigrating from several of Maine's coastal rivers, including the Narraguagus, Penobscot, Pleasant and Sheepscot Rivers. NEST uses RSTs to estimate smolt populations, enumerate and sample smolts (and other co-occurring species), to better understand factors that limit smolt production and migration success. RSTs are also platforms for the telemetry studies that provide valuable data on smolt behavior and migratory success.

RSTs are positioned in the water channels to maximize fish capture. Fish enter the trap through the large end of a revolving and half-submerged screen cone suspended between two pontoons. As the river current turns the cone, the fish are guided downstream into a *live car*, where they are held in river water until retrieved for sampling. Traps are tended daily, so fish spend as little time as possible in the live car. As smolts tend to move downstream at night, they often confined for less than 12 hours.



RSTs require adequate water depth and current to rotate the cone for most effective "fishing." Although RSTs can be used in high flow conditions, they sometimes become jammed with debris. River conditions are monitored closely to prevent fish injury. RSTs are equipped with a hubodometer that records the number of revolutions of the cone, allowing for an estimation of catch per unit of effort.

Given their design, the main utility of the RSTs is as a sampling platform. Coupled with telemetry, NEST can paint a picture of emigrating smolt dynamics.

A Sampling Platform

General Sampling: All smolts captured in the RSTs are counted and the following information recorded:

- length (mm)
- weight (g)
- fin condition/deformities
- degree of smoltification based on external characteristics
- marks (e.g. fin clips)
- tags (e.g. VIE and PIT tags)
- injuries (e.g. from dam turbines or predators)

Priority for further biological sampling varies by river site, but is sometimes given to smolts with certain marks and/or tags, as well as those presumed to be of naturally reared origin.

Scale samples: taken for age and origin (hatchery or naturally reared) determination.

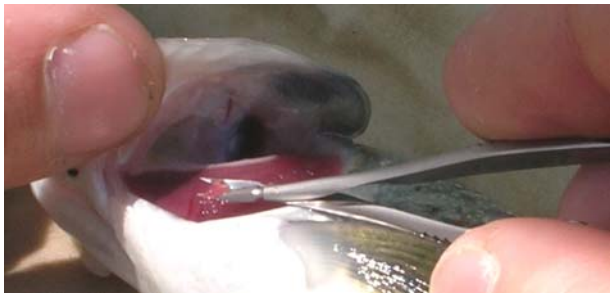
Gill and blood plasma samples: collected to assess the degree of smoltification and a smolt's physiological condition.

Fin tissue samples: taken for use in genetic determination of parentage, as well as relating captured smolts to fry stocking data and tissue data collected from pre-spawn adults at state weirs/fish traps.

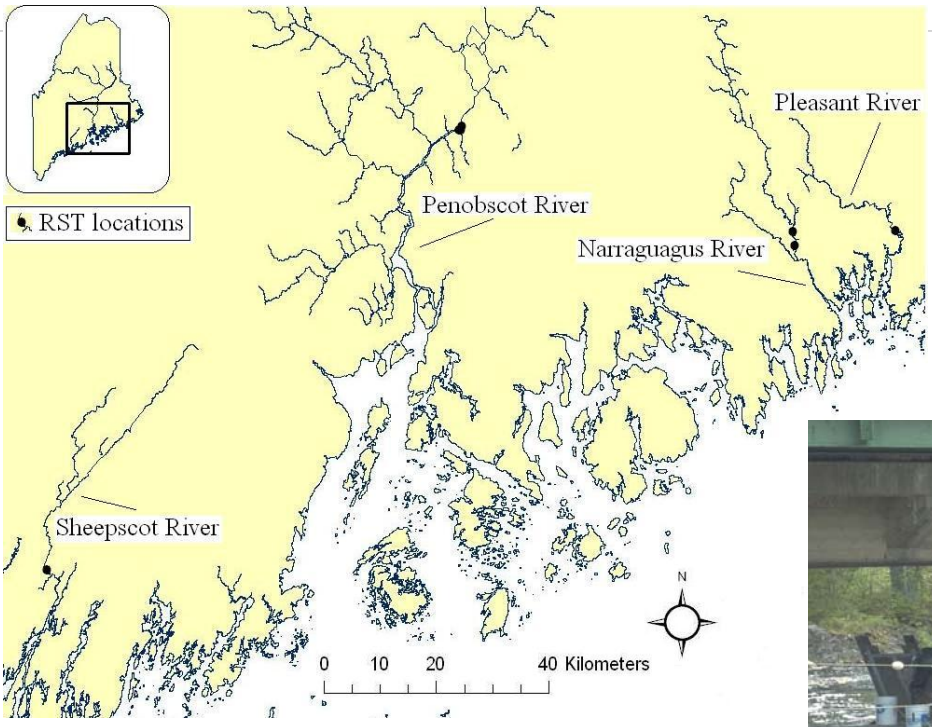
Non-target species: All non-target species (resident and sea-run) are identified and counted, and biological samples are taken from some as part of NEST's disease survey of Northeast and North Atlantic fishes. Species that occupy the same space as Atlantic salmon in rivers provide a unique ecological dataset that improves our understanding of river health and productivity, as well as predator-prey dynamics and *diadromous connectivity* (the structure of co-evolved sea-run fish communities).

Two NEST technicians tend a RST on the Sheepscot River. This includes netting out and sampling captured fish, cleaning out any debris, and checking the hubodometer.

Left, Graham Goulette measures the length of a captured smolt and John Kocik records a smolt's weight (right).



Trent Liebich obtains blood (above) and gill (below) samples from this smolt to assess its physiological condition.



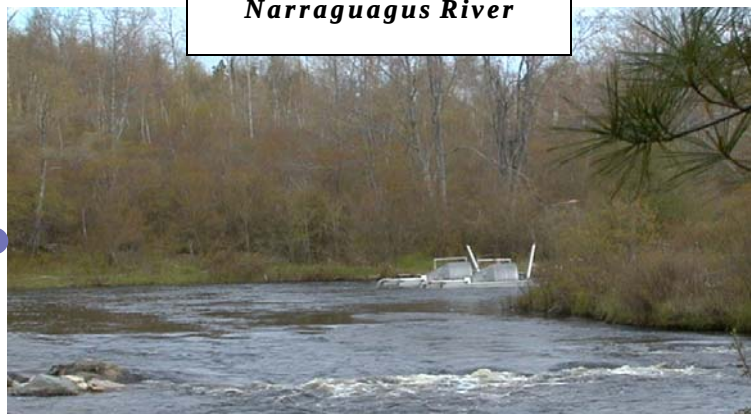
Map depicting RST locations on the Sheepscot, Penobscot, Narraguagus and Pleasant Rivers.

Pleasant River

NEST fished RSTs on Eastern Maine's Pleasant River from 1999-2004. The Pleasant River RST was used to collect naturally reared (i.e. wild-spawned and fry stocked) and hatchery reared smolts with several goals in mind, including enumeration and the collection of biological samples.

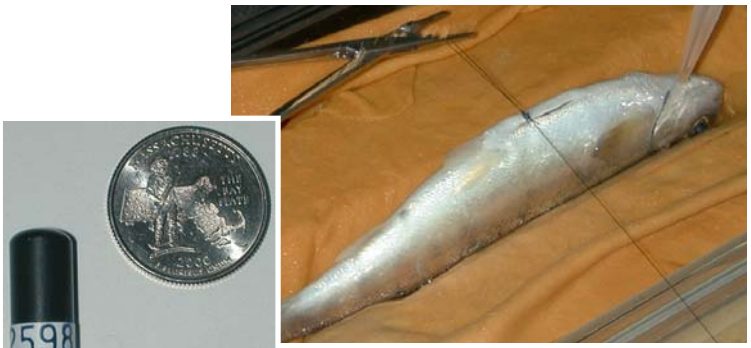
Additionally, from 2001-2003, naturally reared suspects were collected to create a broodstock for hatchery production of Pleasant River fish. Finally, in 2004, the Pleasant River RST was used to collect naturally and hatchery reared fish to tag as part of an ultrasonic telemetry study.

Narraguagus River



RST operations have been conducted on Eastern Maine's Narraguagus River since 1996, providing NEST researchers with the largest RST dataset to date. A multi-site mark recapture study (ongoing since 1997) allows NEST researchers to not only estimate the annual population of outmigrating smolts, but also gain a better understanding of overwinter survival using juvenile population estimates from the Maine Atlantic Salmon Commission's electrofishing surveys conducted the previous fall.

The Narraguagus River RSTs were also used as a platform to collect naturally reared smolts for various ultrasonic telemetry studies. Results from these telemetry studies were used to assess smolt survivorship and behavior (1997-1999 and 2002-2005). A cormorant exclusion study, coupled with the 2004-2005 telemetry study, assessed the non-lethal exclusion of cormorants from the smolt migratory corridor during peak migration.



RSTs on the Narraguagus and Pleasant River have been used to catch fish for use in telemetry studies. Ultrasonic transmitters, or "pingers," (above left) are surgically transplanted into collected fish which are then released. Fixed-site automated fish identification receivers (VR2) arrays detect passing fish with pingers.

Penobscot

From 2000-2005, NEST operated RSTs in Maine's largest river, the Penobscot. In addition to collecting smolts and obtaining biological samples, NEST researchers conducted a mark-recapture study to evaluate downstream passage of smolts through hydroelectric facilities and RST capture efficiency.

Looking upstream at the Veazie Dam from one of NEST's RSTs on the Penobscot River. RSTs enable NEST researchers to collect smolts traveling downstream that pass through such facilities.

Although sampling and conducting population estimates in a river of this size is challenging, NEST anticipates that the information gleaned from the mark-recapture study will be useful in refining smolt stocking strategies (e.g. timing and location) to maximize the number of returning hatchery reared adults.

Sheepscot

When initiated in 2001, the original focus of RST operations on Mid-coast Maine's Sheepscot River was enumerating smolts and obtaining biological samples. NEST researchers have since expanded the focus to include an evaluation of Craig Brook National Fish Hatchery's conservation stocking program.

Additionally, NEST is in the very early stages of investigating diadromous connectivity on the Sheepscot by coupling hydroacoustic technology with trapping activities. At historic abundance levels, Maine's native complex of sea-run species likely provided a prey buffer against Atlantic salmon predators, as well as a source of marine-derived nutrients and food for various life stages. Although some anadromous species (migrate from sea to spawn in freshwater) are captured, RSTs are not designed to target fish traveling upstream. The use of hydroacoustics to assess the composition of the sea-run community present during the smolt emigration period will help bolster our understanding of ecosystem-level processes and how interactions between diadromous species might affect salmon recovery.

The anadromous American shad .

The NOAA's National Marine Fisheries Service (NMFS) Northeast Salmon Team (NEST) is comprised of managers from the Northeast Regional Office (NER) and scientists from the Northeast Fisheries Science Center (NEC). The NER administers NOAA's programs in the Northeastern United States to manage living marine resources for optimum use. The NEC is the research arm of NOAA Fisheries in the region and plans, develops, and manages a multidisciplinary program of basic and applied research. More Atlantic salmon information is available at www.XXXXXXXXXXXXX.